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EFFECTS OF DELAYED INITIAL SALTING ON TRANSIT TEMPERATURES OF CALIFORNIA LETTUCE SHIPPED BY RAIL

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Growth Through Agricultural Progress

SUMMARY AND CONCLUSIONS

Five paired-car shipments of lettuce were shipped from Salinas, Calif., to determine if the dangerously low air temperatures that frequently occur under the floor racks at the shipping point in pre-iced and pre-salted cars could be prevented by delaying the initial salting until the first re-icing. The effect of such a delay on subsequent transit temperatures was also determined.

Subfreezing air temperatures under the floor racks occurred at the shipping point in all cars initially salted at Salinas but did not occur in any car in which initial salting was delayed until Roseville (first re-icing station).

Air blast temperatures in three of the cars in which initial salting was delayed were slightly warmer between the shipping point and the first re-icing station. However, average air blast and lettuce temperatures for the entire trip were the same for all cars salted at Salinas and all cars initially salted at Roseville.

Lettuce temperatures did not reach freezing in these tests. In cars precooled to the desirable temperature of 32° F. and initially salted at shipping point, however, lettuce near the bottom bunker position would be in danger of freezing injury during the time the cars stand on track at shipping or assembly points. Delaying the initial salting until the first re-icing station would reduce this danger without adversely affecting the average temperature of the lettuce in transit and therefore may be recommended as a precautionary measure.

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EFFECTS OF DELAYED INITIAL SALTING ON TRANSIT TEMPERATURES OF CALIFORNIA LETTUCE SHIPPED BY RAIL

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Lettuce arriving at eastern markets sometimes shows freezing injury in parts of the load. Subfreezing air temperatures in pre-iced and pre-salted cars may occur under the floor racks while the cars are standing at the shipping point.[1] Test cars of lettuce were shipped from Salinas, Calif., to eastern markets to determine the effect of delaying the initial salting on air temperatures before shipment and on subsequent transit temperatures of the lettuce. The cars were shipped during August and October 1958 and August and September 1959.

This study of the effects of delayed initial salting is part of a broad program of continuing research designed to reduce the cost of marketing farm products.

PROCEDURE

Ten cars of vacuum-cooled lettuce were shipped in pairs; one car of each pair was initially salted at the shipping point (Salinas, Calif.) and the other was initially salted at the first re-icing station (Roseville, Calif.). All cars were pre-iced, shipped full-bunker standard refrigeration, and initially salted to 2 percent of bunker capacity. The cars in each pair were pre-iced at the same time, loaded on the same day, and shipped by the same route (table 1).

The percentage of salt added at each re-icing station was specified by the individual shipper and thus varied between pairs of cars, but not between cars in any one pair. The effect of the various percentages of salt added at each re-icing cannot be determined from these data as no two pairs of cars were shipped at the same time. However, the effect of different salting practices has been studied previously.[2]

All cars, except C and D (pair 2), were iced the day before loading, which is the normal procedure at Salinas. Cars C and D were iced and loaded on the same day because of a temporary shortage of cars, which resulted in a more rapid utilization of the available equipment.

Temperatures in transit were taken with recording thermometers placed in three cartons of lettuce in each car. These test packages were loaded in the bottom layer at the bunker, middle layer at the quarter-length, and the top layer at the doorway position. Slightly different positions were used in the second pair of cars (table 2). Recording thermometers were also placed in the air blast in front of the top bulkhead openings and under the floor racks about 2 feet from the bunker to record air temperatures.

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[1] Barger, W. R., Stewart, J. K., Harvey, J. M., and others. Transit Temperatures of California Lettuce. U. S. Dept. Agr. Mktg. Res. Rpt., 285, 16 pp., illus.

[2] See footnote 1.

TABLE 1.--Salting of test cars of lettuce shipped with standard refrigeration from Salinas, Calif., to eastern markets

Car	Date shipped	Destination	Initial salting		Salt added at each re-icing[2]
			Station	Amount of salt[1]	
				Percent	Percent
Pair No. 1:					
A............	August 27, 1958	Newark, N. J.	Salinas	2	3
B............	do.	New York City	Roseville	2	3
Pair No. 2:					
C............	October 9, 1958	New York City	Salinas	2	2
D............	do.	do.	Roseville	2	2
Pair No. 3:					
E............	August 19, 1959	Newark, N. J.	Salinas	2	4
F............	do.	do.	Roseville	2	4
Pair No. 4:					
G............	August 20, 1959	Philadelphia	Salinas	2	4
H............	do.	do.	Roseville	2	4
Pair No. 5:					
I............	Sept. 16, 1959	Newark, N. J.	Salinas	2	4
J............	do.	do.	Roseville	2	4

[1] Percent of bunker capacity.
[2] Percent of the ice supplied.

RESULTS

Air Temperatures

Air temperatures in cars salted at Salinas and those initially salted at Roseville differed primarily in the minimums reached under the floor racks while the cars stood on the track at the shipping point. The minimum air temperature beneath the floor rack at the shipping point was below the freezing point of lettuce (31.5°) in cars salted at Salinas and above the freezing point of lettuce in cars salted at Roseville (table 3). At Salinas the average minimum air temperature under the floor racks was 26° for the cars salted at shipping point and 37° for the cars in which initial salting was delayed until the first re-icing.

An average of approximately 28 hours elapsed between the time the test cars were loaded and the time they were re-iced at the first re-icing station, which was 219 miles from the shipping point. The cars were moving slowly during about half of this time and were standing, primarily at the shipping point, during the remaining time.

While the cars were en route between the shipping point and the first re-icing station, minimum air temperatures under the floor racks averaged 31° F. for the cars salted at Salinas and 37° for those initially salted at Roseville.

These subfreezing air temperatures that occur in cars initially salted at the shipping point are dangerous to well precooled lettuce located near the bottom bunker position.

Delaying the initial salting until Roseville did not affect the average air temperatures under the floor racks. These temperatures were the same, or varied by only 1 degree, TABLE 2.--Average transit temperatures of lettuce at indicated positions in cars shipped from Salinas, Calif., to eastern markets

Car	Salt initially supplied (Station)	Lettuce temperatures at--		
		Bottom bunker	Middle quarter	Top door
		°F.	°F.	°F.
Pair No. 1:				
A	Salinas	37	38	38
B	Roseville	36	38	38
Pair No. 2:				
C	Salinas	[1] 34	34	[2] 34
D	Roseville	[1] 34	34	[2] 34
Pair No. 3:				
E	Salinas	38	39	39
F	Roseville	38	38	38
Pair No. 4:				
G	Salinas	(3)	39	40
H	Roseville	39	(3)	41
Pair No. 5:				
I	Salinas	39	38	39
J	Roseville	39	39	40
Average of cars initially salted at				
Salinas		[4] 37	[4] 37	38
Roseville		[4] 37	[4] 37	38

[1] Middle bunker.
[2] Top bunker.
[3] Thermometer failed.
[4] Temperatures in cars G and H not included in average.

for cars in any pair (table 3). The average of these air temperatures for all cars salted at Salinas was the same as that for all cars initially salted at Roseville (36°).

Air blast temperatures in pairs 1, 2, and 3 were slightly cooler between Salinas and Roseville in the cars receiving salt at the shipping point than in those receiving initial salt at the first re-icing station (fig. 1). After the first re-icing station, no consistent differences in air blast temperatures occurred between cars initially salted at Salinas or Roseville. These temperatures were similar within each pair of test cars, and the average air blast temperature in transit for all cars salted at Salinas was the same as that for all cars salted at Roseville (36° F.).

Minimum air blast temperatures in transit were also similar in cars of each pair, and the average for all cars salted at either Salinas or Roseville was the same (31° F.).

Lettuce Temperatures

Temperature of the lettuce at time of loading was typical for vacuum-cooled lettuce, ranging from 36° to 39° F. The optimum temperature of 32° for maximum retention of quality in lettuce is seldom attained because of the longer cooling period required and the increased hazard of freezing as the vacuum process is prolonged.

TABLE 3.--Air temperatures in test cars of lettuce shipped from Salinas, Calif., to eastern markets

Car	Salt initially supplied (Station)	Air temperature in car				
		Under floor rack			Fan blast, in transit	
		Minimum at Salinas	In transit			
			Minimum	Average	Minimum	Average
		° F.	° F.	° F.	° F.	° F.
Pair No. 1:						
A	Salinas	28	28	37	32	35
B	Roseville	38	31	37	33	36
Pair No. 2:						
C	Salinas	29	30	33	29	34
D	Roseville	38	28	32	29	33
Pair No. 3:						
E	Salinas	24	30	36	32	37
F	Roseville	35	29	36	32	38
Pair No. 4:						
G	Salinas	24	32	37	31	38
H	Roseville	36	29	38	29	37
Pair No. 5:						
I	Salinas	24	33	37	31	36
J	Roseville	36	32	38	31	36
Average of cars initially salted at						
Salinas		26	31	36	31	36
Roseville		37	30	36	31	36

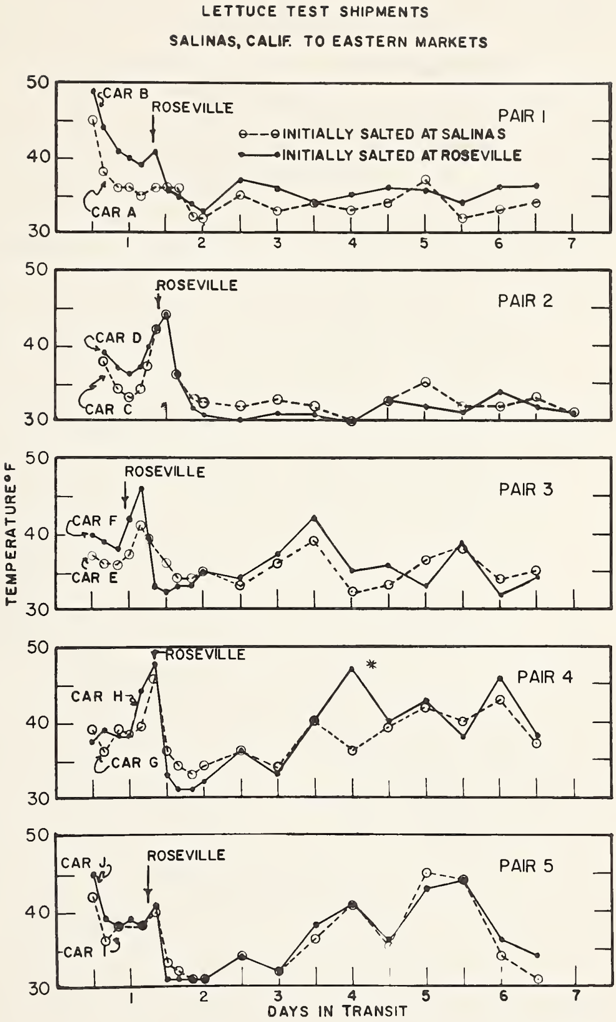
Average transit temperatures of lettuce at the bottom bunker, middle quarter, and top doorway positions were uniform within each car. Within any one car these temperatures did not vary by more than 2 degrees and in most cars the variation was not greater than 1 degree (table 2).

Differences in lettuce temperature between the two cars in any one pair also were small. Average commodity temperatures in transit were the same or varied by only 1 degree in paired cars. This uniformity of temperature also was evident at any given position in the cars. The average temperature for the entire trip ranged from 34° (pair no. 2) to 40° (pair no. 4). These temperatures are acceptable for lettuce although the lower temperatures are recommended.

In pairs 2, 3, 4, and 5, lettuce temperatures were either the same or only 1 degree warmer during the first 2 days in the car initially salted at Roseville than in the companion car initially salted at Salinas (fig. 2). Temperature differences were slightly greater during the first 2 days between cars in pair 1. However, the average load temperatures for the entire trip were approximately the same for the latter pair of cars (37° vs. 38° F.).

Temperatures of lettuce in the bottom layer were slightly cooler during the first 2 days in the cars initially salted at Salinas than in the cars initially salted at Roseville. However, the lettuce did not reach freezing temperatures in any of the test cars.

Transit temperatures of lettuce were not consistently different in cars salted at Salinas or initially salted at Roseville.



*Air temperature rise due to layover of car for repairs.

Figure 1.--Effect of adding initial salt at shipping point (Salinas) or the first re-icing station (Roseville) on air-blast temperatures in transit.

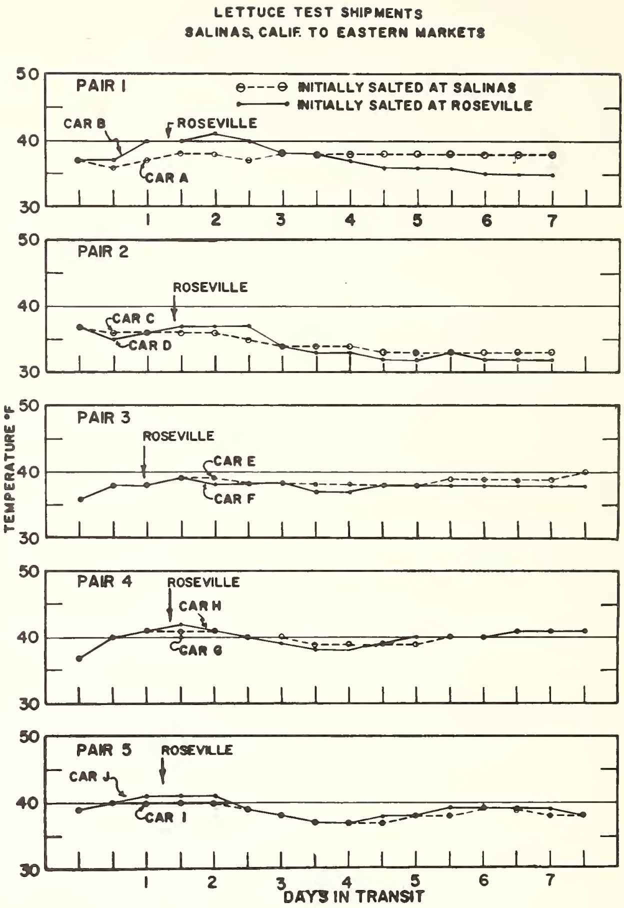


Figure 2.--Effect of adding initial salt at the shipping point (Salinas) or the first re-icing station (Roseville) on lettuce temperatures in transit. Average of bottom bunker, middle quarter, and top doorway positions (except as noted in table 2).